



A new record for *Brachycephalus nodoterga* (Amphibia, Anura, Brachycephalidae) in the state of São Paulo, Brazil

Arthur Diesel Abegg^{1*}, Flora Roncolatto Ortiz², Bruno Rocha² and Thais Helena Condez³

1 Universidade Federal de Santa Maria, Laboratório de Biologia Evolutiva, Avenida Roraima, 1.000, Camobi, CEP 97105-900, Santa Maria, RS, Brazil

2 Instituto Butantan, Laboratório Especial de Coleções Zoológicas, Avenida Vital Brasil, 1.500, Butantã, CEP 05503-900 São Paulo, SP, Brazil

3 Universidade Estadual Paulista, Instituto de Biociências, CEP 13506-900. Rio Claro, SP, Brazil

* Corresponding author. E-mail: arthur_abegg@hotmail.com

Abstract: The species *Brachycephalus nodoterga*, classified as Data Deficient by the IUCN, is recorded from a fifth known locality. Four specimens were collected north of Osasco, in the mountain range of the São Roque group, São Paulo, Brazil. A map was generated with the occurrence points of the species throughout its geographical distribution.

Key words: Osasco, geographical distribution, Atlantic Forest

The genus *Brachycephalus* comprises 29 species of small anurans, endemic to the Atlantic Forest phytogeographical domain (Pombal and Izecksohn 2011; Frost 2015; Ribeiro et al. 2015). It is associated with leaf litter inside forests from northeastern Brazil, in the state of Bahia, to southern Brazil, in the state of Santa Catarina (Napoli et al. 2011; Pie et al. 2013; Ribeiro et al. 2015). The vast majority of its species live in high altitude areas, occurring generally above 600 m (Garey et al. 2012).

Brachycephalus was considered a monotypic genus for almost 200 years, and only in the 1990s (Pombal 1999) taxonomic rearrangements and the description of new species have resulted in a considerable increase in its diversity (Alves et al. 2006; Alves et al. 2009; Napoli et al. 2011; Ribeiro et al. 2015). A phylogenetic hypothesis for the genus was proposed recently (Clemente-Carvalho et al. 2011). Despite the growing number of studies involving the genus *Brachycephalus*, many species are known only from the type locality and surroundings and are often included in the category of Data Deficient (DD) in the list of endangered species of the International Union for Conservation of Nature (IUCN) (Silvano et al. 2004; Garey et al. 2012).

Brachycephalus nodoterga Miranda-Ribeiro, 1920 is predominantly yellow throughout its body, with darker

coloration on the back of the head, trunk and limbs, tending to greenish brown (Pombal 2010). The dorsal surface of the body is covered with dermal ossification, characterized as small protruding beads (Pombal 2010; Condez et al. 2014). It was originally described as a variety of *Brachycephalus ephippium* (Miranda-Ribeiro, 1920) and was treated as a full species in Heyer et al. (1990). However, the taxonomic identity of the species was questioned (Silvano et al. 2004). In a detailed review of the varieties of *B. ephippium*, Pombal (2010) compared the population examined by Heyer et al. (1990) from the Estação Biológica de Boracéia, in Salesópolis, state of São Paulo, with the type material of *B. nodoterga* from Serra da Cantareira, and confirmed the validity of the species.

Data on the natural history of *B. nodoterga* are nonexistent. However, similar to other species of the genus, it is presumed to present direct development (Pombal 1999). The geographical distribution is also incipient, and the occurrence of the species is only known for four localities, all in the state of São Paulo. In addition to the type locality in Serra da Cantareira, presumed to be inside of the Parque Estadual da Cantareira, cities of São Paulo and Mairiporã, there are populations of *B. nodoterga* in other three forest remnants: in city of Santana de Parnaíba; in the Estação Biológica de Boracéia, cities of Biritiba Mirim and Salesópolis; and in Morro do Ramalho, Parque Estadual de Ilhabela, city of Ilhabela (Figure 1) (Pombal and Izecksohn 2011); Herein, we present a new record for *B. nodoterga*, establishing the fifth locality in the state of São Paulo.

The new record was made at about 820 m of altitude on the Fazenda Paiva Ramos ($23^{\circ}28'20.95''$ S, $046^{\circ}47'25.52''$ W), in the mountain range of the São Roque group, north of the city of Osasco, state of São Paulo (Henrique-Pinto and Janasi 2010). Several specimens were found in October 2014 and January 2015. Four specimens were collected by A.D. Abegg, F.R. Ortiz and T.H. Condez

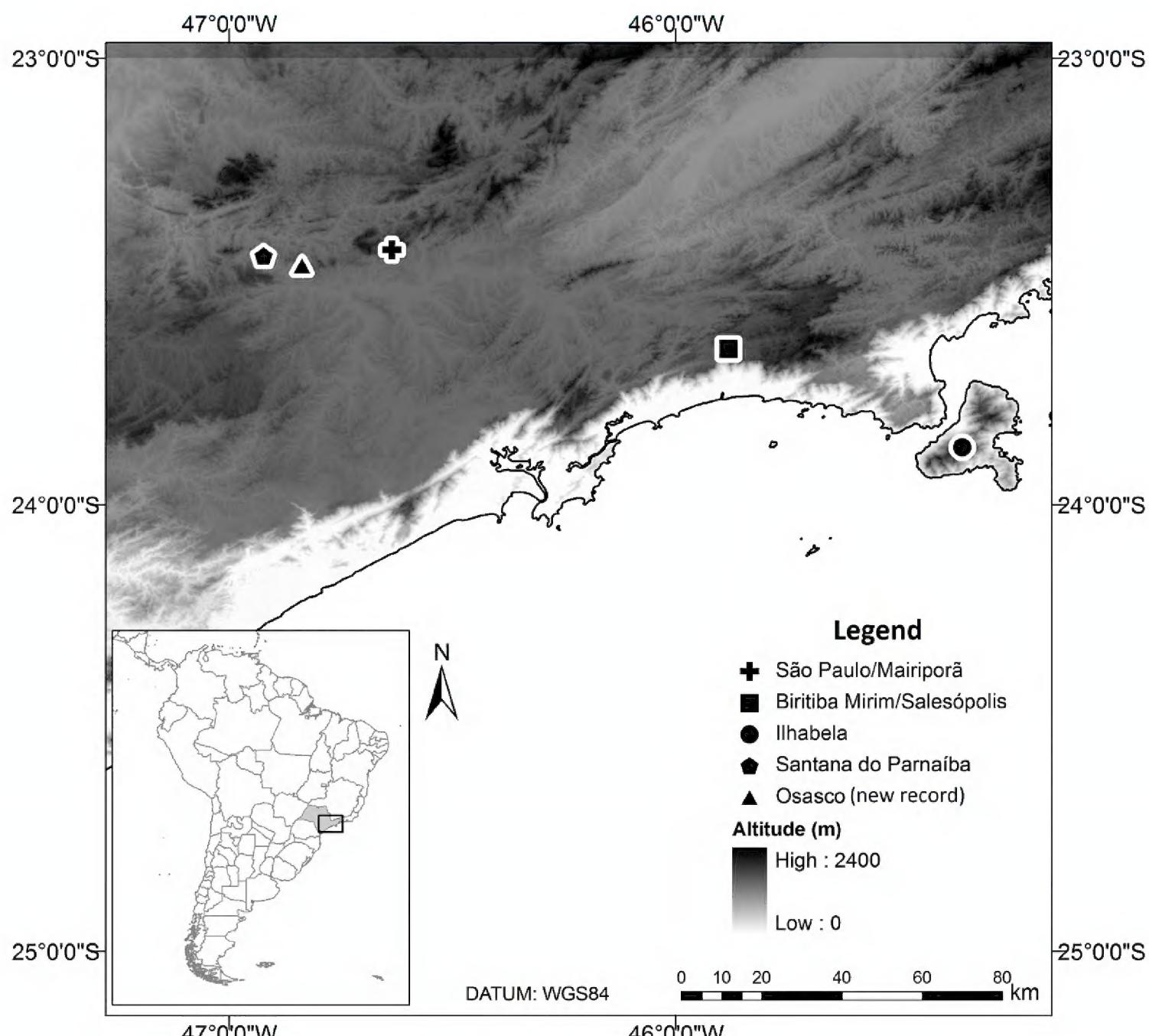


Figure 1. Distribution map for *Brachycephalus nodoterga* with the new record in Osasco (triangle), state of São Paulo, Brazil. Other symbols represent the literature records.

(Collecting permit SISBio 23501-6) (Figure 2), euthanized with anesthetic overdose (Lydocain 2%) and deposited in the herpetological collection of the Instituto Butantan «Alphonse Richard Hoge», São Paulo, Brazil (IBSPCR), identified with the voucher numbers of IBSPCR 1202, 1205, 1206 and 1207.

The referred specimens were identified based on morphological comparative analysis using material from scientific collections. The specimens from Osasco

show the external morphology of *B. nodoterga* as per the original description (Miranda-Ribeiro, 1920) and subsequent comments made by Pombal (2010). They agree with other specimens currently assigned to *B. nodoterga* from Parque Estadual da Cantareira (CFBH 28413, MNRJ 73674, 73675, MZUSP 975, 112785-112791), Santana de Parnaíba (CFBH 9606, MZUSP A147711-A147722), Estação Biológica de Boracéia (MZUSP 30625, 30626 and 30653) and Parque Estadual de Ilhabela (CFBH 7030-7042, 7045-7048, MNRJ 23633-23636, 23638-23640).

All individuals were captured in the leaf litter next to a stream in the forest. The species appears to have reproduction activity associated with the rainy season, because males were observed vocalizing sparsely during the morning and afternoon and vocalization peaks were observed in the evening. This behavior is similar to that observed for other species of the genus (Garey et al. 2012; Condez et al. 2014).

Brachycephalus nodoterga, as *B. ephippium* (Pie et al. 2013), is known from diverse populations (Clemente-Carvalho et al. in press) and, currently, can be considered as one of the exceptions within the genus, in which most species have restricted distribution to one or two localities (Ribeiro et al. 2015). Our record of *B. nodoterga*

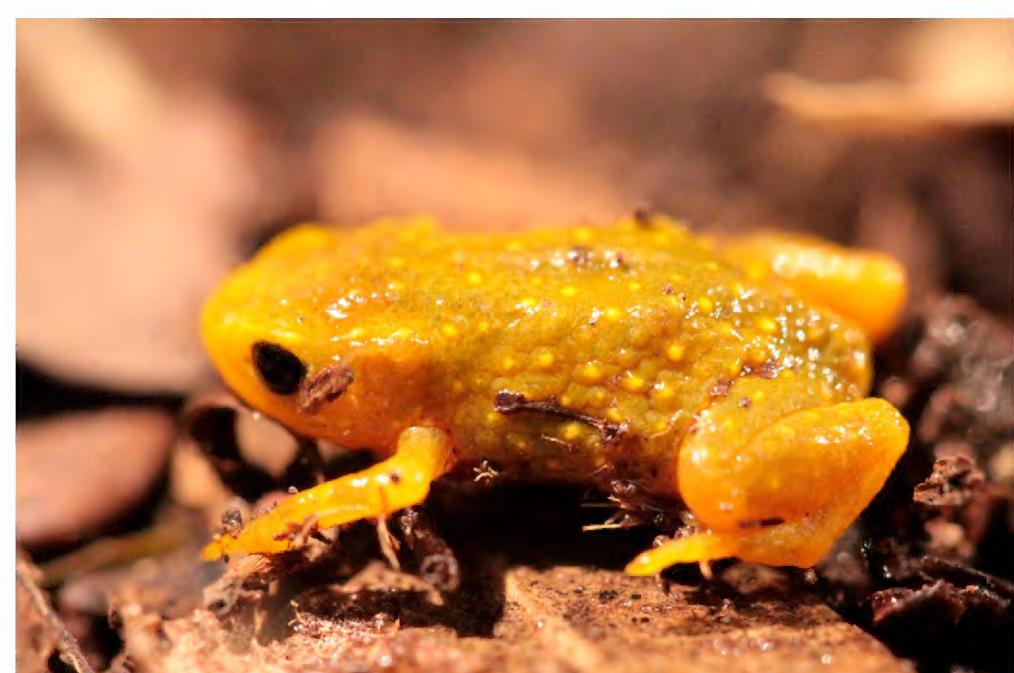


Figure 2. Specimen of *Brachycephalus nodoterga* collected Fazenda Paiva Ramos (23°28'20.95" S, 046°47'25.52" W), north of city of Osasco, state of São Paulo, Brazil.

from north of Osasco fills a gap of 33 km between two points in the distribution of the species (Santana do Parnaíba – Mairiporã, São Paulo) and is located approximately 13 km southeast of Santana do Parnaíba. In total, five localities are recognized to maintain this species. Material from Península do Bororé, city of São Paulo (23°47'11" S, 046°38'45" W; CFBH 11623), identified by Pie et al. (2013) as *B. cf. nodoterga*, clearly refers to another species and was not included in the range of *B. nodoterga*. The dorsal hyperossified bony shield led us to assign this individual to the *B. ephippium* group.

In a recent national evaluation of the risk of extinction of the Brazilian fauna, *B. nodoterga* was included in the category of Data Deficient (DD) (MMA 2014). Its occurrence in the Atlantic Forest remnants from the metropolitan region of São Paulo suggests that populations may be exposed to distinct pressures, including those resulting from changes in natural environments, forest fragmentation and habitat loss. This new record reinforces the need for further studies on the biology and distribution of the species and provides data to support the evaluation of the conservation status of *B. nodoterga*.

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LITERATURE CITED

Alves, A.C.R., L.F. Ribeiro, C.F.B. Haddad and S.F. Reis. 2006. Two new species of *Brachycephalus* (Anura: Brachycephalidae) from the Atlantic Forest in Paraná State, southern, Brazil. *Herpetologica* 62(2): 221–233. doi: [10.1655/05-41.1](https://doi.org/10.1655/05-41.1)

Alves, A.C.R., R.J. Sawaya, S.F. Reis and C.F.B. Haddad. 2009. New species of *Brachycephalus* (Anura: Brachycephalidae) from the Atlantic Rain Forest in São Paulo state, southeastern, Brazil. *Journal of Herpetology* 43(2): 212–219. doi: [10.1643/CH-09-102](https://doi.org/10.1643/CH-09-102)

Clemente-Carvalho, R.B.G., J. Klaczko, S.I., Perez, A.C. Alves, C.F.B. Haddad, S.F. dos Reis. 2011. Molecular phylogenetic relationships and phenotypic diversity in miniaturized toadlets, genus *Brachycephalus* (Amphibia: Anura: Brachycephalidae). *Molecular Phylogenetics and Evolution* 61(1): 79–89. doi: [10.1016/j.ympev.2011.05.017](https://doi.org/10.1016/j.ympev.2011.05.017)

Clemente-Carvalho, R.B.G., S.I. Perez, C.H. Tonhatti, T.H. Condez, R.J. Sawaya, C.F.B. Haddad and S.F. dos Reis. [In press]. Boundaries of morphological and molecular variation and the distribution range of a miniaturized froglet, *Brachycephalus nodoterga* (Anura: Brachycephalidae). *Journal of Herpetology*. doi: [10.1670/14-119](https://doi.org/10.1670/14-119)

Condez, T.H., R.B. Clemente-Carvalho, C.F.B. Haddad and S.F. dos Reis. 2014. A New Species of *Brachycephalus* (Anura: Brachycephalidae) from the Highlands of the Atlantic Forest, Southeastern Brazil. *Herpetologica* 70: 89–99. doi: [10.1655/HERPETOLOGICA-D-13-00044](https://doi.org/10.1655/HERPETOLOGICA-D-13-00044)

Frost, D.R. 2015. Amphibian species of the world: an online reference. Version 6.0 Accessed at <http://research.amnh.org/vz/herpetology/amphibia/>, January 2015.

Garey, M.V., A.M.X. Lima, M.T. Hartmann and C.F.B. Haddad. 2012. A new species of miniaturized toadlet, genus *Brachycephalus* (Anura: Brachycephalidae), from Southern Brazil. *Herpetologica* 68(2): 266–271. doi: [10.1655/HERPETOLOGICA-D-11-00074.1](https://doi.org/10.1655/HERPETOLOGICA-D-11-00074.1)

Henrique-Pinto, R. and V.A. Janasi. 2010. Metaconglomerados e rochas associadas do Grupo São Roque a norte da cidade de São Paulo, Brasil. *Brazilian Journal of Geology* 40(3): 409–425. <http://rbg.sbg.org.br/index.php/rbg/article/view/16307/1222>

Heyer, W.R., A.S. Rand, C.A.G. Cruz, O.L. Peixoto and C.E. Nelson. 1990. Frogs of Boracéia. *Arquivos de Zoologia* 31(4): 231–410. doi: [10.11606/issn.2176-7793.v31i4p231-410](https://doi.org/10.11606/issn.2176-7793.v31i4p231-410)

MMA (Ministério do Meio Ambiente). 2014. Fauna brasileira ameaçada de extinção. portaria nº 444, de 17 de dezembro de 2014. Accessed at <http://www.icmbio.gov.br/portal/>, 10 September 2015.

Miranda-Ribeiro, A. 1920. Os brachycephalídeos do Museu Paulista. *Revista do Museu Paulista* 12: 306–318. <http://biodiversitylibrary.org/page/10804591>

Napoli, M., U. Caramasch, C.A.G. Cruz and I.R. Dias. 2011. A new species of flea-toad, genus *Brachycephalus* Fitzinger (Amphibia: Anura: Brachycephalidae), from the Atlantic Rain forest of southern Bahia, Brazil. *Zootaxa* 2739: 33–40. doi: [10.11646/zootaxa.2739.1.3](https://doi.org/10.11646/zootaxa.2739.1.3)

Pie, M.R., A.L.S. Meyer, C.R. Firkowski, L.F. Ribeiro and M.R. Bornschein. 2013. Understanding the mechanisms underlying the distribution of microendemic montane frogs (*Brachycephalus* spp., Terrarana: Brachycephalidae) in the Brazilian Atlantic Rainforest. *Ecological Modelling* 250: 165–176 doi: [10.1016/j.ecolmodel.2012.10.019](https://doi.org/10.1016/j.ecolmodel.2012.10.019)

Pombal, J.P. 1999. Oviposição de desenvolvimento de *Brachycephalus ephippium* (Anura, Brachycephalidae). *Revista Brasileira de Zoologia* 16(4): 967–976. doi: [10.1590/S0101-81751999000400004](https://doi.org/10.1590/S0101-81751999000400004)

Pombal, J.P. 2010. A posição taxonômica das “variedades” de *Brachycephalus ephippium* (Spix, 1824) descritas por Miranda-Ribeiro, 1920 (Amphibia, Anura, Brachycephalidae). *Boletim do Museu Nacional. Zoologia* 526: 1–12.

Pombal, J.P. and E. Izecksohn. 2011. Uma nova espécie de *Brachycephalus* (Anura, Brachycephalidae) do Estado do Rio de Janeiro. *Papéis Avulsos de Zoologia* 51(28): 443–451. doi: [10.1590/S0031-10492011002800001](https://doi.org/10.1590/S0031-10492011002800001)

Ribeiro, L.F., M.R. Bornschein, R. Belmonte-Lopes, C.R. Firkowski, S.A.A. Morato and M.R. Pie. 2015. Seven new microendemic species of *Brachycephalus* (Anura: Brachycephalidae) from southern Brazil. *PeerJ* 3: e1011. doi: <https://doi.org/10.7717/peerj.1011>

Silvano, D., R. Heyer, U. Caramaschi. 2004. *Brachycephalus nodoterga*. The IUCN Red List of threatened species 2004: e.T54454A11149387. doi: [10.2305/IUCN.UK.2004.RLTS.T54454A11149387.en](https://doi.org/10.2305/IUCN.UK.2004.RLTS.T54454A11149387.en)

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